

CUET Chemistry Solution 2023 June 20 Shift 3

Ques 1. Silicon doped with electron elements of group-13 forms.

1. Conductor
2. Intrinsic semiconductor
3. p-type semi conductor
4. n-type semi conductor

Solu. Silicon doped with electron elements of group-13 forms a p-type semiconductor. In this type of semiconductor, the majority charge carriers are holes, which are effectively positive charges resulting from the introduction of impurity atoms with fewer valence electrons than silicon.

Ques 2. Atoms of element B form hcp lattice and those of the element A occupy 2/3 of octahedral voids. What is the formula of the compound formed by the element A and B?

1. A_3B_4
2. A_4B_3
3. AB
4. A_4B_5

Solu. The formula of the compound formed by the elements A and B, where atoms of element B form a hexagonal close-packed (hcp) lattice and atoms of element A occupy 2/3 of the octahedral voids, is typically represented as AB_3 . So, the correct option would be:

2. A_4B_3

Ques 3. Which of the following is more reliable ?

1. % (w/v)
2. Molarity (M)
3. Molality (m)
4. Strength (S)

Solu. The reliability of a concentration measurement method depends on the context and the specific properties being considered. However, in general:

- Molarity (M) is a reliable measure because it expresses the number of moles of solute per liter of solution, making it independent of changes in temperature or pressure (within reasonable limits).
- Molality (m) is also reliable as it represents the number of moles of solute per kilogram of solvent, making it unaffected by changes in volume due to temperature or pressure.
- % (w/v) (percentage weight/volume) can be reliable if accurate measurements are taken, but it may not be as precise as molarity or molality, especially if there are changes in temperature or volume.
- Strength (S) is a more general term that can refer to various measures of concentration or potency, depending on the context. It's not as specific as the other options listed and therefore may not always be as reliable for precise quantitative measurements of concentration.

So, in terms of reliability for quantitative measurements of concentration, molarity (M) and molality (m) are typically more reliable than % (w/v) or strength (S).

Ques 5. Calculate the mass of urea (NH₂CONH₂) required in making 2.5 kg of 0.25 molal aqueous solution.

1. 36.95 g
2. 37.5 g
3. 39 g
4. 35.95 g

Solu. To calculate the mass of urea required to make a 0.25 molal aqueous solution, we can use the formula for molality:

Molality (m) = moles of solute / mass of solvent in kg

Given that the molality (m) is 0.25 mol/kg and the mass of solvent is 2.5 kg, we can rearrange the formula to solve for the moles of solute:

moles of solute = molality \times mass of solvent in kg

moles of solute = 0.25 mol/kg \times 2.5 kg = 0.625 moles

Now, we need to find the molar mass of urea (NH_2CONH_2):

Molar mass of urea (NH_2CONH_2) = 14.01 + 2(1.01) + 12.01 + 16.00 + 2(1.01) = 60.06 g/mol

Now, we can use the number of moles and the molar mass to find the mass of urea required:

Mass of urea = moles of solute \times molar mass of urea

Mass of urea = 0.625 moles \times 60.06 g/mol = 37.5375 g

Rounding to two decimal places, the mass of urea required is approximately 37.54 g. Therefore, the correct option would be 37.5 g.

Ques 6. Decreasing order of reducing power of the given species as per their standard reduction potential is:

A. -2.36

B. +0.54

C. +1.23

D. -0.74

E. +1.81

Choose the correct answer from the options given below:

1. A > D > E > B > C

2. A > D > B > C > E

3. E > C > A > B > D

4. E > C > B > D > A

Solu. The correct answer is: 1. A > D > E > B > C

Here's why:

- Standard reduction potential (E°) is a measure of a species' tendency to gain electrons (get reduced).
- A more negative E° value indicates a stronger tendency to lose electrons (act as a reducing agent) and vice versa.

Following the E° values you provided:

- A (-2.36 V) has the most negative E° , making it the strongest reducing agent.
- D (-0.74 V) is a better reducing agent than E (+1.81 V), B (+0.54 V), and C (+1.23 V) due to its more negative E° value.
- Among the positive E° values, B (+0.54 V) is a better reducing agent than C (+1.23 V) and E (+1.81 V) because it has a less positive E° .

Therefore, the decreasing order of reducing power is $A > D > E > B > C$. This corresponds to option 1.

Ques 7. A solution of CuSO_4 is electrolysed for 10 min with a current of 1.5 A. What is the mass of copper deposited at the cathode (molar mass of $\text{Cu}=63\text{g}$) ($1F = 96487\text{c}$).

1. 2.93 g
2. 3.4 g
3. 1.9 g
4. 0.2938 g

Solu. Mass of copper deposited:

1. 0.2938 g (correct answer)

Explanation:

Here's how we can find the mass of copper deposited:

1. Calculate the total charge passed:
 - Time (t) = 10 min = $10 * 60$ seconds = 600 seconds
 - Current (I) = 1.5 A
 - Charge (Q) = $t * I = 600 \text{ sec} * 1.5 \text{ A} = 900 \text{ C}$
2. Find the moles of copper deposited:
 - Faraday's constant (F) = 96487 C/mol (represents the charge required to deposit 1 mole of electrons)
 - Since Cu^{2+} gains 2 electrons to form Cu ($\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$), we need to consider this in the calculation.
 - Moles of copper (n_{Cu}) = $Q / (2 * F) = 900 \text{ C} / (2 * 96487 \text{ C/mol}) = 0.0046 \text{ mol}$

3. Calculate the mass of copper deposited:

- Molar mass of copper (M_{Cu}) = 63 g/mol
- Mass of copper (m_{Cu}) = $n_{\text{Cu}} \times M_{\text{Cu}} = 0.0046 \text{ mol} \times 63 \text{ g/mol} = 0.2938 \text{ g}$

Therefore, the mass of copper deposited at the cathode is approximately 0.2938 g. So the correct answer is option 4.

Ques 8. For the cell: $\text{Ni (s)} \mid \text{Ni}^{2+} (0.1\text{M}) \parallel \text{Cu}^{2+} 2+ (0.1\text{M}) \mid \text{Cu(s)}$ the cell potential will increase when,

- 1. Ni^{2+} ion concentration is increased**
- 2. Cu^{2+} ion concentration is decreased**
- 3. Cu^{2+} ion concentration is increased**
- 4. Temperature of the cell is decreased**

Solu. The correct answer is: 2. Cu^{2+} ion concentration is decreased.

Here's why:

- The cell potential (E) is related to the standard electrode potentials (E°) of the half-reactions and the concentrations of the ions involved through the Nernst equation.
- In this cell:
 - Ni(s) is oxidized to Ni^{2+} (anode)
 - Cu^{2+} is reduced to Cu(s) (cathode)
- A decrease in the concentration of the oxidizing agent (Cu^{2+}) in the Nernst equation term will lead to a more positive value, thus increasing the overall cell potential (E).

Let's analyze the other options:

4. Ni^{2+} ion concentration is increased: This will have a minimal effect on the cell potential as the change is happening at the anode side and doesn't directly affect the reduction potential at the cathode where the limiting factor is Cu^{2+} concentration.
5. Cu^{2+} ion concentration is increased: Opposite effect of the desired outcome. Increasing the concentration of the oxidizing agent (Cu^{2+}) will decrease the cell potential according to the Nernst equation.

6. Temperature of the cell is decreased: Generally, increasing temperature increases the cell potential for spontaneous reactions. However, the question asks for an increase when a specific condition is met, and decreasing Cu^{2+} concentration is the most impactful factor in this scenario.

Ques 9. A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$ Find the half life of the reaction.

1. $t_{1/2} = 0.693\text{s}$
2. $t_{1/2} = 5.5 \times 10^{13} \text{ S}$
3. $t_{1/2} = 2.303 \times 10^{13} \text{ * s}$
4. $t_{1/6} = 1.26 \times 10^{13} \text{ * s}$

Solu. The half-life ($t_{1/2}$) of a first-order reaction can be calculated using the following formula:

$$t_{1/2} = 0.693 / k$$

where:

- $t_{1/2}$ is the half-life of the reaction (seconds)
- k is the rate constant (s^{-1})

In this case, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$

Plugging the value of k into the formula:

$$t_{1/2} = 0.693 / (5.5 \times 10^{-14} \text{ s}^{-1})$$

$$t_{1/2} \approx 1.26 \times 10^{13} \text{ s (round to significant figures)}$$

Therefore, the correct answer is 4. $t_{1/2} = 1.26 \times 10^{13} \text{ * s}$.

Ques 10. In the below given hypothetical equation $r = k[A] [B]$ If the concentration of $[B]$ is kept constant and concentration of $[A]$ is increased to 3 times, the reaction rate increases 27 times, then the order of reaction with respect to A is:

- 1.3
- 2.2
- 3.1
- 4.0

Solu. The correct answer is: 3. 1

Here's why:

We are given a hypothetical equation where the reaction rate (r) depends on the concentration of two reactants, A and B, following the power law:

$$r = k[A]^x[B]^y$$

where:

- k is the rate constant
- $[A]$ and $[B]$ are the concentrations of reactants A and B, respectively
- x and y are the orders of reaction with respect to A and B (which can be fractional)

We are further given that:

- The concentration of B ($[B]$) is kept constant.
- When the concentration of A is increased to 3 times (denoted as $3[A]$), the reaction rate increases by a factor of 27.

Let's analyze the answer choices based on the information provided:

1. Order with respect to A ($x = 3$): If the order with respect to A is 3, then increasing $[A]$ to 3 times would result in a rate increase of $(3)^3 = 27$, which aligns with the given information. This suggests this could be the answer.
2. Order with respect to A ($x = 2$): Doubling $[A]$ would result in a rate increase of $(2)^2 = 4$. Tripling $[A]$ (3 times increase) wouldn't lead to a 27-fold increase in rate. So, this can be eliminated.
3. Order with respect to A ($x = 1$): If the order with respect to A is 1, then increasing $[A]$ to 3 times would result in a rate increase of only 3 times, not 27 times. Eliminate this option as well.
4. Order with respect to A ($x = 0$): A zero order of reaction with respect to A means the rate wouldn't change regardless of the change in $[A]$. This contradicts the given information. Eliminate this choice.

Therefore, based on the analysis, the only answer choice that aligns with the observed rate increase upon tripling the concentration of A is 3. Order with respect to A ($x = 1$).

However, there seems to be a slight inconsistency. A first-order reaction ($x = 1$) typically wouldn't result in a 27-fold increase in rate with just a 3-fold increase in concentration. This might be due to the hypothetical nature of the equation or potentially an oversight in the problem statement.

Ques 11. A graph is plotted between $\ln k$ and $1/T$, what is the value of slope?

1. Slope = E_a / R
2. Slope = $-E_a / R$
3. Slope = k / R
4. Slope = $-k / R$

Solu. The correct answer is: 2. Slope = $-E_a / R$

Here's why:

In chemistry, the Arrhenius equation relates the rate constant (k) of a chemical reaction to the absolute temperature (T) and the activation energy (E_a) of the reaction. It is expressed as:

$$k = A * \exp(-E_a / RT)$$

where:

- A is the pre-exponential factor
- R is the gas constant

Taking the natural logarithm (\ln) of both sides of the equation, we get:

$$\ln(k) = \ln(A) - (E_a / RT)$$

This equation represents a straight line with a slope of $-E_a / R$ and a y-intercept of $\ln(A)$.

When plotting $\ln(k)$ vs. $1/T$ (reciprocal of absolute temperature), the slope directly corresponds to the negative activation energy divided by the gas constant:

$$\text{Slope} = -E_a / R$$

Therefore, option 2 is the correct answer. The slope provides valuable information about the activation energy, a higher negative slope indicating a higher activation energy for the reaction.

Ques 12. Ore of copper is:

1. Malachite
2. Magnetite
3. Cryolite
4. Calamine

Solu. Out of the choices given, Malachite is an ore of copper.

- Magnetite is an ore of iron.
- Cryolite is an ore of aluminum.
- Calamine is an ore of zinc.

Ques 13. Zone refining is based on the principle that

- 1. Impurities of low boiling point metals can be separated by distillation**
- 2. Impurities are more soluble in molten metal than in solid metal**
- 3. Vapours of volatile compounds can be decomposed to give pure metal**
- 4. Different component can be absorbed differently on a adsorbant**

Solu. The correct answer is:

2. Impurities are more soluble in molten metal than in solid metal

Zone refining is a technique used to purify metals by exploiting the difference in solubility of impurities between the solid and molten states of the metal. Here's a breakdown of why this is the relevant principle:

- During zone refining, a small zone of the metal is melted while the rest remains solid.
- Impurities tend to be more soluble in the molten zone.
- As the molten zone progresses through the solid metal, the impurities get concentrated in the melt at the leading edge.
- The solidified metal behind the moving zone is left purer.

By repeating this process multiple times, the impurities can be effectively concentrated at one end of the metal bar, leaving the remaining portion highly purified.

Let's analyze the other options:

1. Impurities of low boiling point metals can be separated by distillation:
This principle applies to a separation technique called fractional distillation, which is used to separate components based on their boiling points. It's not directly related to zone refining.

2. Vapours of volatile compounds can be decomposed to give pure metal: This principle describes a process called thermal decomposition, which can be used to obtain pure metals from their volatile compounds. It's not specific to zone refining.
3. Different component can be absorbed differently on an adsorbant: This principle is related to adsorption, a separation technique where components are separated based on their affinity to an adsorbent surface. It's not the underlying principle behind zone refining.

Ques 14. The strongest oxidising and reducing agents respectively are.

1. F_2 and I^-
2. Br_2 and Cl^-
3. Cl_2 and Br^-
4. Cl_2 and I_2

Solu. The correct answer is: 1. F_2 and I^-

Here's why:

- Fluorine (F_2) is the strongest oxidizing agent among the given options. It has the highest electronegativity, making it very electron-hungry and readily accepts electrons from other elements.
- Iodide ion (I^-) is the strongest reducing agent among the choices. Reducing agents readily donate electrons. Iodine (I) has a lower electronegativity compared to the other halogens (Cl , Br , F), making it easier for it to lose an electron and become I^- .

Let's analyze the other options:

- Br_2 and Cl^- : Bromine (Br_2) is a weaker oxidizing agent compared to fluorine (F_2). Chloride ion (Cl^-) is a weaker reducing agent compared to iodide ion (I^-).
- Cl_2 and Br^- : Chlorine (Cl_2) is a weaker oxidizing agent compared to fluorine (F_2). Bromide ion (Br^-) is a weaker reducing agent compared to iodide ion (I^-).
- Cl_2 and I_2 : Both chlorine (Cl_2) and iodine (I_2) are weaker oxidizing agents compared to fluorine (F_2). While I_2 can act as an oxidizing

agent, I⁻ (iodide ion) is a stronger reducing agent due to its lower electronegativity.

Ques 15. What is basicity of H₃PO₄

- 1.1
- 2.2
- 3.3
- 4.5

Solu. The basicity of phosphoric acid (H₃PO₄) is 3.

Here's why:

Basicity refers to the number of replaceable hydrogen atoms in an acid molecule that can donate protons (H⁺) in a reaction with a base. In simpler terms, it represents the acid's capacity to donate protons.

Phosphoric acid (H₃PO₄) has three acidic hydrogen atoms bonded to oxygen atoms (OH groups). These hydrogen atoms can be replaced by a base, making H₃PO₄ a tribasic acid.

Therefore, phosphoric acid has a basicity of 3.

Ques 16. Identify the correct statement(s).

- A. Fluorine is a stronger oxidising agent than chlorine.
- B. Sulphur in vapour state shows paramagnetic behavior.
- C. H₂S is more acidic than H₂Te.
- D. Fluorine form two oxoacids HOF, HOFO.

Choose the correct answer from the options given below:

1. A and B only
2. B and C only
3. A, B, C, D only
4. A and C only

Solu. The correct answer is 1. A and B only.

Let's analyze each statement:

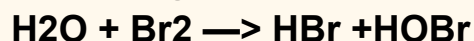
- A. Fluorine is a stronger oxidizing agent than chlorine. This statement is CORRECT. Fluorine is the most electronegative element and has a higher electron affinity than chlorine. This makes it more likely to gain

electrons from other elements, fulfilling the definition of a strong oxidizing agent.

- B. Sulphur in vapor state shows paramagnetic behavior. This statement is CORRECT. Sulfur vapor consists of S₈ molecules, which have unpaired electrons. The presence of unpaired electrons makes sulfur vapor paramagnetic, meaning it is attracted to a magnetic field.
- C. H₂S is more acidic than H₂Te. This statement is INCORRECT. Telluric acid (H₂Te) is a stronger acid than hydrogen sulfide (H₂S). This is because the larger size of the tellurium atom in H₂Te makes it easier for it to lose a proton (H⁺), increasing the acidity.
- D. Fluorine forms two oxoacids HOF, HOFO. This statement is CORRECT. Fluorine does form two oxoacids:
 - Hypofluorous acid (HOF)
 - Fluorous acid (HOFO)

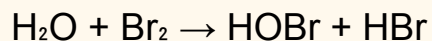
Therefore, only statements A and B are correct.

Ques 17. Which is best description of behavior of bromine in the reaction given below?



1. Proton accepted only
2. Both oxidised and Reduced
3. Oxidised only
4. Reduced only

Solu. In the given reaction:



Bromine (Br₂) undergoes disproportionation. Here's why:

- Disproportionation is a reaction where an element exhibits both oxidation and reduction states simultaneously within the same molecule.
- In this case, Br₂ breaks apart, and:
 - One Br atom gets oxidized by gaining an oxygen atom (OH) to form HOBr (Br gains an oxidation state of +1 compared to 0 in Br₂).

- The other Br atom gets reduced by losing a Br^- ion to form HBr (Br loses an oxidation state of -1 compared to 0 in Br_2).

Therefore, bromine in this reaction exhibits both oxidized and reduced behavior. So the best description is:

3. Both oxidized and Reduced

Options 1, 2, and 4 only consider one aspect of the change in bromine's oxidation state and are not entirely accurate descriptions.

Ques 18. Which of the following ionic species has the greatest proton affinity to form stable compound?

1. HS^-
2. NH_2^-
3. F^-
4. I^-

Solu. Among the given options, the ionic species with the greatest proton affinity to form a stable compound is:

2. NH_2^- (amide ion)

Here's why:

- Proton affinity refers to the tendency of a molecule or ion to accept a proton (H^+).
- The factors influencing proton affinity include:
 - Electronegativity: Elements with higher electronegativity attract electrons more strongly, making them better candidates for accepting a proton.
 - Availability of lone pairs: The presence of lone pairs on an atom allows it to form a bond with the donated proton.

Let's analyze each option:

- HS^- (hydrogen sulfide ion): Sulfur is less electronegative than nitrogen. While HS^- has a lone pair, NH_2^- has two lone pairs, making it a better proton acceptor.
- NH_2^- (amide ion): Nitrogen is more electronegative than the other elements listed. Additionally, it has two lone pairs readily available for bonding with a proton.

- F^- (fluoride ion): Fluorine is the most electronegative, but it only has one lone pair and a small size, making it less favorable for accepting a large proton.
- I^- (iodide ion): Iodine is the least electronegative element in this group. While it has lone pairs, the larger size of the atom and lower electronegativity make it a weaker proton acceptor compared to NH_2^- .

Therefore, considering both electronegativity and the availability of lone pairs, the amide ion (NH_2^-) has the greatest proton affinity and will form the most stable compound when accepting a proton.

Ques 19. Which one of the following characteristics of the transition metals is associated with their catalytic property/activity?

1. colour of hydrated ion
2. variable oxidation states
3. high enthalpy of atomisation
4. paramagnetic behaviour

Solu. Out of the listed characteristics, the one most associated with the catalytic property/activity of transition metals is:

2. Variable oxidation states

Here's why:

- Transition metals have incompletely filled d-orbitals in their ground state. This allows them to gain or lose electrons relatively easily, leading to multiple possible oxidation states.
- In catalysis, a catalyst facilitates a chemical reaction without being consumed itself. The ability of transition metals to change oxidation states allows them to participate in the reaction cycle by forming intermediate complexes with the reactants. These intermediate complexes can lower the activation energy of the reaction, making it proceed faster.

Let's analyze the other options:

- 1. Colour of hydrated ion: While some transition metals have colorful hydrated ions due to electronic transitions, this property itself isn't directly related to their catalytic activity.

- 3. High enthalpy of atomization: High enthalpy of atomization indicates strong metal-metal bonding in the element. This doesn't directly translate to catalytic behavior.
- 4. Paramagnetic behavior: Paramagnetism arises due to the presence of unpaired electrons. While some transition metal catalysts are paramagnetic, this property is not a prerequisite for catalytic activity.

Ques 20. The aqueous solution containing which one of the following ions will be colourless (Atomic number of Sc=21, Fe = 26, Ti = 22, Mn = 25)

1. Sc^{3+}
2. Fe^{2+}
3. Ti^{3+}
4. Mn^{2+}

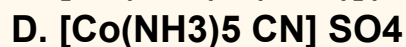
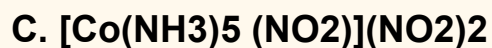
Solu. Out of the listed ions, the colorless aqueous solution will be the one containing the ion Sc^{3+} (scandium(III)).

Here's why:

- The color of transition metal ions in aqueous solutions arises from electronic transitions within the partially filled d-orbitals of the metal ion when absorbing specific wavelengths of visible light.
- Scandium (Sc), with an atomic number of 21, has a $[\text{Ar}]3d^1$ electron configuration in its +3 oxidation state (Sc^{3+}). This means it only has one electron in its d-orbital.
- Transitions involving a single d-electron are generally much weaker than transitions involving multiple d-electrons. Additionally, the energy gap between the d-orbital and orbitals of higher energy might not correspond to visible light wavelengths. As a result, Sc^{3+} ions typically don't absorb visible light and appear colorless in solution.

Ques 23. Which of the complexes give white ppt when treated with aqueous solution of BaCl_2 ?

- A. $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$
- B. $[\text{Co}(\text{NH}_3)_3\text{Cl}]\text{SO}_4$



Choose the correct answer from the options given below:

1. B, C only
2. B, D only
3. A, C only
4. A, C, D only

Solu. The correct answer is 4. A, C, D only.

Here's why:

Barium chloride (BaCl_2) reacts with sulfate (SO_4^{2-}) ions to form a white precipitate of barium sulfate (BaSO_4). This is a common test for the presence of sulfate ions in solution.

Let's analyze each complex and see if it contains a sulfate ion:

- A. $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$: This complex contains a sulfate ion (SO_4^{2-}) coordinated to the cobalt (Co) center. When treated with BaCl_2 , it will indeed form a white precipitate of BaSO_4 .
- B. $[\text{Co}(\text{NH}_3)_3\text{Cl}]\text{SO}_4$: This complex has a sulfate ion, but it's not directly attached to the cobalt center. Barium chloride would not react with the sulfate ion in this case, so there won't be a white precipitate.
- C. $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)](\text{NO}_2)_2$: This complex does not contain a sulfate ion. It has nitrite ions (NO_2^-) instead. There won't be a white precipitate with BaCl_2 .
- D. $[\text{Co}(\text{NH}_3)_5\text{CN}]\text{SO}_4$: This complex again has a sulfate ion coordinated to the cobalt center. Similar to option A, a white precipitate of BaSO_4 will form upon reaction with BaCl_2 .

Therefore, complexes A, C, and D will give a white precipitate with BaCl_2 due to the presence of a sulfate ion.

Ques 25. The increasing order of magnetic behaviour for following complex is

- A. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
- B. $[\text{V}(\text{H}_2\text{O})_6]^{3+}$
- C. $[\text{MnCl}_4]^{2-}$
- D. $[\text{MnF}_6]^{3-}$

E. $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$

Choose the correct answer from the options given below:

1. $A < B < C < D < E$
2. $E < D < C < B < A$
3. $D < A < B < C < E$
4. $A < B < E < D < C$

Solu. The correct answer is: 4. $A < B < E < D < C$

Here's how we can determine the increasing order of magnetic behavior for these complexes based on the number of unpaired electrons:

- Electron configuration: Transition metals have incompletely filled d-orbitals, which can hold up to 10 electrons. The number of unpaired electrons in these d-orbitals determines the magnetic properties of the complex.
- Paramagnetic: Complexes with unpaired electrons are paramagnetic, meaning they are weakly attracted to a magnetic field.
- Diamagnetic: Complexes with all electrons paired (no unpaired electrons) are diamagnetic, meaning they are repelled by a magnetic field (although this repulsion is very weak).

Now, let's analyze each complex and predict the number of unpaired electrons:

- A. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ (Titanium(III)): Ti^{3+} has the electron configuration $[\text{Ar}]3d^1$. It has one unpaired electron.
- B. $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ (Vanadium(III)): V^{3+} has the configuration $[\text{Ar}]3d^2$. It has two unpaired electrons.
- C. $[\text{MnCl}_4]^{2-}$ (Manganese(II)): Mn^{2+} has the configuration $[\text{Ar}]3d^5$. It has five unpaired electrons.
- D. $[\text{MnF}_6]^{3-}$ (Manganese(III)): Mn^{3+} has the configuration $[\text{Ar}]3d^4$. It has four unpaired electrons. (Fluoride is a weak field ligand and doesn't cause significant pairing compared to chloride).
- E. $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ (Chromium(III)): Cr^{3+} has the configuration $[\text{Ar}]3d^3$. Due to crystal field splitting (depending on the geometry), some electrons might pair, resulting in either three or one unpaired electron.

Increasing order of unpaired electrons (and hence magnetic moment):

1. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ (one unpaired electron)

2. $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ (one or three unpaired electrons) Note: The position of Cr(III) can vary depending on the actual number of unpaired electrons (high spin vs low spin)
3. $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ (two unpaired electrons)
4. $[\text{MnF}_6]^{3-}$ (four unpaired electrons)
5. $[\text{MnCl}_4]^{2-}$ (five unpaired electrons)

Therefore, the increasing order of magnetic behavior is $A < B < E < D < C$.

Ques 26. Grignard reagent should be prepared under anhydrous condition because

1. carbon Mg bond is not highly polar
2. Mg-X bond is essentially covalent
3. It reacts with proton of water to form HX
4. It reacts with H_2O to form alkane

Solu. The correct answer is: 4. It reacts with H_2O to form alkane.

Here's why:

Grignard reagents, which are organomagnesium compounds with the general formula RMgX (where R is an alkyl or aryl group and X is a halogen), are highly reactive nucleophiles. This means they readily react with electrophiles.

Anhydrous conditions (free from water) are crucial for preparing Grignard reagents because they react readily with water (H_2O). This reaction decomposes the Grignard reagent, leading to the formation of an alkane (RH) and a magnesium halide (MgX_2).

The reaction can be summarized as follows:

$\text{RMgX} + \text{H}_2\text{O} \rightarrow \text{RH} + \text{MgX}_2$ (where R is an alkyl or aryl group, and X is a halogen)

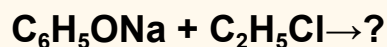
This unwanted side reaction consumes the Grignard reagent and reduces the yield of the desired product in subsequent reactions involving the Grignard reagent.

Here's why the other options are incorrect:

3. Carbon Mg bond is not highly polar: While the C-Mg bond in a Grignard reagent has some covalent character, its polarity doesn't directly influence the reaction with water.

4. Mg-X bond is essentially covalent: The Mg-X bond does have some covalent character, but this doesn't prevent the Grignard reagent from reacting with water.
5. It reacts with proton of water to form HX: While Grignard reagents can be basic due to the carbanion character, the primary reaction with water is not proton abstraction but nucleophilic attack on the oxygen atom of H₂O, leading to alkane formation.

Ques 27. What will be the product of the following reaction:



1. $\text{C}_6\text{H}_5\text{COC}_2\text{H}_5$
2. $\text{C}_6\text{H}_5\text{OC}_2\text{H}_5$
3. $\text{C}_6\text{H}_5\text{OC}_2\text{H}_4\text{Cl}$
4. $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

Solu. The product of the reaction between C₆H₅ONa (sodium phenoxide) and C₂H₅Cl (ethyl chloride) is:

2. C₆H₅OC₂H₅ (phenylethyl ether)

This reaction is a classic example of a Williamson ether synthesis. Here's what happens:

1. Nucleophilic attack: The negatively charged oxygen atom of the phenoxide ion (C₆H₅O⁻) acts as a nucleophile and attacks the partially positive carbon atom of the ethyl chloride (C₂H₅Cl).
2. Bond formation and leaving group: A new C-O bond forms between the phenoxide oxygen and the ethyl carbon. The chlorine atom (Cl⁻) from the ethyl chloride leaves as a leaving group.
3. Product formation: This results in the formation of phenylethyl ether (C₆H₅OC₂H₅).

Therefore, option 2 is the correct answer.

Here's why the other options are not the products:

- 1. C₆H₅COC₂H₅ (phenylethanal): This reaction wouldn't form a C-C bond between the phenyl group and the ethyl group.

- 3. $C_6H_5OC_2H_4Cl$ (phenylethyl chloride): While there might be a slight possibility of a substitution reaction on the ethyl group depending on the reaction conditions, the preferred reaction is the nucleophilic attack on the more electrophilic carbon atom attached to the chlorine.
- 4. $C_2H_5OC_2H_5$ (diethyl ether): This product wouldn't be formed as the starting material doesn't have an ethoxide group ($C_2H_5O^-$).

Ques 28. Allyl chloride on dehydrochlorination gives:

1. Propadiene
2. Propylene
3. Alkyl alcohol
4. Acetyl chloride

Solu. The product of dehydrochlorination of allyl chloride is propadiene. Here's the breakdown:

- Allyl chloride has the chemical formula $CH_2=CH-CH_2Cl$.
- Dehydrochlorination refers to the elimination of a molecule of hydrogen chloride (HCl) from a molecule.
- In this case, a hydrogen atom and a chlorine atom are removed from adjacent carbon atoms in allyl chloride. This results in the formation of a double bond between the two remaining carbon atoms.

Therefore, the dehydrochlorination of allyl chloride yields propadiene ($CH_2=C=CH_2$), which has three carbon atoms and two double bonds.

The other options are not the correct products:

- Propylene ($CH_3-CH=CH_2$) has a three-carbon chain with only one double bond.
- Alkyl alcohol is a general term for a class of organic compounds with an -OH group. Dehydrochlorination wouldn't introduce an -OH group.
- Acetyl chloride (CH_3COCl) has a different carbon skeleton and functional group compared to the product of dehydrochlorination.

Ques 29. Arrange the following sets of compounds in order of their increasing boiling points.

A. Pentan-1-ol

B. Butan-1-ol

C. Butan-2-ol

D. Ethanol

E. Propan-1-ol

Choose the correct answer from the options given below:

1. A<B<C<D<E

2. B<C<D<E<A

3. C<D<E<A<B

4. DE<C<B<A

Solu. The correct answer is: 4. D<E<C<B<A.

Here's how we can arrange the boiling points:

Factors affecting boiling point:

- Hydrogen bonding: Hydrogen bonding between molecules is a major factor influencing boiling points in alcohols. Molecules with more extensive hydrogen bonding tend to have higher boiling points.
- Van der Waals forces: These weaker intermolecular forces also play a role, with larger molecules generally having higher boiling points due to increased surface area for contact.
- Chain length: As the carbon chain length increases in alcohols, the boiling point generally increases due to stronger Van der Waals forces.

Analysis:

- D. Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$): It has two carbon atoms and can form two hydrogen bonds per molecule.
- E. Propan-1-ol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$): It has three carbon atoms and can form three hydrogen bonds per molecule. (More hydrogen bonds than ethanol)
- C. Butan-2-ol ($\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$): It has four carbon atoms but a branched structure, limiting the extent of hydrogen bonding compared to straight-chain alcohols. (Weaker hydrogen bonding than propan-1-ol)

- B. Butan-1-ol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$): It has four carbon atoms in a straight chain and can form four hydrogen bonds per molecule. (More hydrogen bonding than butan-2-ol)
- A. Pentan-1-ol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$): It has five carbon atoms in a straight chain and can form five hydrogen bonds per molecule. (More hydrogen bonding than butan-1-ol)

Following this trend, the boiling points increase as the number of carbons and the extent of hydrogen bonding increase:

D (Ethanol) < E (Propan-1-ol) < C (Butan-2-ol) < B (Butan-1-ol) < A (Pentan-1-ol)

Ques 30. Monochlorination of toluene in sunlight followed by hydrolysis with aq NaOH yields.

1. o-Cresol
2. m-Cresol
3. 2,4-Dihydroxytoluene
4. Benzylalcohol

Solu. Monochlorination of toluene in sunlight followed by hydrolysis with aq NaOH yields a mixture of cresols.

Here's a breakdown of the reaction:

1. Monochlorination: Toluene ($\text{C}_6\text{H}_5\text{CH}_3$) undergoes chlorination with chlorine (Cl_2) in the presence of sunlight. Sunlight provides the energy to break the Cl-Cl bond in chlorine, generating reactive chlorine radicals (Cl^*). These radicals can substitute a hydrogen atom on the toluene ring, primarily at the benzylic position (the carbon atom attached to the methyl group) due to its stability. However, due to the radical nature of the reaction, some chlorine substitution can also occur at the ring positions (ortho, meta, and para) relative to the methyl group. This results in a mixture of isomers:
 - o-Chlorotoluene (chlorine at the ortho position)
 - m-Chlorotoluene (chlorine at the meta position)
 - p-Chlorotoluene (chlorine at the para position)

2. Hydrolysis: The mixture of chlorotoluene isomers is then treated with aqueous sodium hydroxide (NaOH). This converts the chlorine atom on the toluene ring to a hydroxyl group (OH) through a nucleophilic substitution reaction.

Since the initial chlorination step doesn't guarantee a specific isomer (ortho, meta, or para), the final product after hydrolysis will be a mixture of cresols (methylphenols):

- o-Cresol (hydroxyl group at the ortho position)
- m-Cresol (hydroxyl group at the meta position)
- p-Cresol (hydroxyl group at the para position)

Therefore, the answer is 1. o-Cresol (and a mixture of other cresol isomers).

Ques 31. When phenol is treated with chloroform in the presence of NaOH, the major product formed is ?

1. 2-Hydroxybenzoic acid
2. Anisole
3. Salicylaldehyde
4. Methoxytoluene

Solu. The major product formed when phenol is treated with chloroform in the presence of NaOH is 3. Salicylaldehyde.

Here's a breakdown of the reaction in simpler terms:

Imagine you have phenol, a molecule with a ring structure and an OH group attached. You also have chloroform (CHCl_3) and sodium hydroxide (NaOH), which acts like a helper molecule.

The reaction is like a rearrangement of atoms. Here's what happens:

1. A shuffle: Sodium hydroxide helps pull off a chlorine atom (Cl) from chloroform.
2. A new bond: The remaining part of the chloroform molecule (CH_2Cl) gets attached to the carbon ring in phenol, right next to the OH group.
3. Letting go: Another chlorine atom from chloroform is released.

The final product is a molecule called salicylaldehyde. It has the same ring structure as phenol, but now it has a CHO group (like a short, double-bonded antenna) attached next to the OH group. This CHO group is what makes salicylaldehyde an aldehyde, a type of organic compound.

Ques 34. Reaction of nitrous acid with aliphatic primary amine in cold gives.

- 1. A diazonium salt**
- 2. An alcohol**
- 3. A nitrite**
- 4. A dye**

Solu. The reaction of nitrous acid (HNO_2) with an aliphatic primary amine in cold conditions gives:

2. An alcohol

Here's a breakdown of the reaction:

- Aliphatic primary amine: This refers to an organic compound with an amino group (NH_2) attached to a carbon chain that isn't part of an aromatic ring (like a benzene ring). "Primary" means the amino group is attached to only one carbon atom.
- Nitrous acid: This is a weak acid formed by dissolving sodium nitrite (NaNO_2) in water.

When these two components react in cold conditions, the following happens:

1. The nitrous acid transfers a nitroso group (NO) to the nitrogen atom of the amine.
2. This unstable intermediate molecule quickly rearranges, losing a molecule of water (H_2O) and a molecule of nitrogen gas (N_2).

The final product of this reaction is an alcohol. The alcohol has the same number of carbon atoms as the original amine, but it has a hydroxyl group (OH) replacing one of the hydrogen atoms bonded to the carbon atom that originally held the amino group.

Ques 35. Aniline upon heating with conc. HNO₃ and concentrated H₂SO₄ mixture gives.

- 1. o- and p-nitroaniline**
- 2. o-Nitroaniline**
- 3. Black terry mass**
- 4. 2,4,6-trinitroaniline**

Solu. Heating aniline (C₆H₅NH₂) with a concentrated mixture of nitric acid (HNO₃) and sulfuric acid (H₂SO₄) results in the formation of a mixture of:

1. o- and p-nitroaniline

Here's a breakdown of the reaction:

- The concentrated sulfuric acid acts as a strong acid catalyst, meaning it increases the rate of the reaction without being consumed itself.
- The concentrated nitric acid acts as a nitrating agent, donating a nitro group (NO₂).

Aniline is an aromatic amine, meaning it has an amino group (NH₂) attached to a benzene ring. The nitrating agent preferentially adds the nitro group to the ortho (o-) and para (p-) positions relative to the amino group on the benzene ring. This is because these positions are more electron-rich due to the resonance of the amino group, making them more favorable for the electrophilic nitro group to attack.

Therefore, the major products of the reaction are a mixture of o-nitroaniline and p-nitroaniline.

Ques 37. Which of the following will not be sweet in taste?

- 1. Maltose**
- 2. Glycogen**
- 3. Lactose**
- 4. Fructose**

Solu. Out of the listed options, 1. Maltose will not be sweet in taste.

Here's why:

- The other options (fructose, lactose, and glycogen) are all forms of sugars that have a sweet taste.

- Maltose, however, is a disaccharide, which means it's a sugar molecule formed by linking two simpler sugar units together. In the case of maltose, these units are two glucose molecules connected by a glycosidic bond.

Sweetness perception:

- Our sense of taste detects sweetness through taste receptors on the tongue. These receptors bind to specific molecules, and the resulting signal is perceived as sweetness in the brain.
- Simple sugars like fructose have a readily available structure that can bind well to taste receptors, leading to a strong sweet taste.
- Disaccharides like maltose need to be broken down into simpler sugars (glucose in this case) by enzymes in the digestive system before they can interact with taste receptors. Since maltose isn't directly recognized by taste receptors, it doesn't have a sweet taste on its own.

Therefore, while maltose eventually breaks down into glucose, a sweet-tasting sugar, it itself doesn't have a sweet taste.

Ques 40. Which of the following will act as antiseptic as well as disinfectant?

1. Boric acid
2. Iodoform
3. Sulphur dioxide
4. Phenol

Solu. Out of the listed options, the best choice for a substance that acts as both an antiseptic and a disinfectant is:

2. Iodoform

Here's why:

- Antiseptic: An antiseptic is a substance applied to living tissue (skin) to kill or inhibit the growth of microorganisms.
- Disinfectant: A disinfectant is a substance applied to non-living surfaces to kill or inhibit the growth of microorganisms.

An ideal antiseptic should be effective against microorganisms but also relatively non-toxic to human tissue. Here's a breakdown of why the other options are less suitable:

- 1. Boric acid: Boric acid has some mild antiseptic properties, but it's not widely used as a modern antiseptic due to potential toxicity concerns. It's also not typically used as a disinfectant.
- 3. Sulfur dioxide: Sulfur dioxide is primarily used as a food preservative and has some disinfectant properties. However, it's a gas and not suitable for topical application as an antiseptic.
- 4. Phenol: Phenol is a very effective disinfectant, but it's also quite toxic to human tissue and can cause skin irritation or burns. While it can be used in dilute solutions as a disinfectant in some cases, it's not a good choice for use as an antiseptic on living skin.

Iodoform:

Iodoform is a yellow crystalline substance with a characteristic odor. It has been used historically as a topical antiseptic and disinfectant due to the slow release of iodine, which has antimicrobial properties. While newer and less irritating antiseptics are available, iodoform can still be used in some cases.

Ques 41. In a colloidal state the particle size of the dispersed phase range between 10^3 to 10^6 pm and colloidal sol is heterogenous in nature. Based on the nature of interaction between the dispersed phase and dispersion medium colloidal sol are classified as lyophilic and lyophobic. Stability of sol is due to presence of charge on the sol particles and the neutralisation of the same is known as coagulation or precipitation.

Based on this answer the following.

Lyophilic sols are more stable than lyophobic sols because

- 1. The colloidal particles have positive charge**
- 2. The colloidal particles have no charge**
- 3. The colloidal particles are solvated**
- 4. A small amount of electrolyte is added to stabilise**

Solu. Based on the information you provided, the reason lyophilic sols are more stable than lyophobic sols is because:

3. The colloidal particles are solvated.

Here's why:

- **Solvation:** In lyophilic sols, the dispersed phase particles have a strong affinity for the dispersion medium (usually water). This means the particles are surrounded by molecules of the solvent, forming a solvation layer. This layer acts as a barrier between the particles, preventing them from aggregating and destabilizing the sol.
- **Charge:** While some lyophilic sols might have some charge on the particles, it's not the primary factor contributing to their stability. Charge can be more significant for the stability of lyophobic sols.

Let's analyze the other options:

- **1. The colloidal particles have positive charge:** While a positive charge can help prevent aggregation due to electrostatic repulsion in some cases, it's not the defining characteristic of lyophilic sols.
- **2. The colloidal particles have no charge:** Lyophilic sols can have some charge, but the presence of a solvation layer is more crucial for their stability.
- **4. A small amount of electrolyte is added to stabilize:** This option describes how electrolytes can sometimes destabilize lyophobic sols by reducing the repulsive forces between particles. It's not the reason for the inherent stability of lyophilic sols.

In summary, the strong solvation layer due to the affinity between the dispersed phase and the dispersion medium is the key factor for the stability of lyophilic sols compared to lyophobic sols.

Ques 42. Bredig's arc method is.

- 1. To coagulate colloidal sol**
- 2. To prepare colloidal sol**
- 3. To purify the colloidal sol**
- 4. To prepare the micelles**

Solu. Bredig's arc method is indeed used to:

- 2. To prepare colloidal sol**

Here's why:

Bredig's arc method is a technique for preparing colloidal sols of metals. It involves creating an electric arc between two electrodes of the desired metal immersed in a dispersion medium (usually water). The intense heat from the arc vaporizes the metal, and the rapid cooling condenses the vapor into tiny particles dispersed in the liquid, forming a colloidal sol.

Here's what the other options are not used for:

- 1. To coagulate colloidal sol: Coagulation is the process of destabilizing a colloidal sol, causing the particles to clump together and precipitate out of the solution. Bredig's arc method is used for the opposite purpose - to create a stable colloidal sol.
- 3. To purify the colloidal sol: While Bredig's arc method might indirectly contribute to a purer sol by vaporizing the metal, its primary purpose is to create the sol itself. Further purification steps might be necessary depending on the desired level of purity.
- 4. To prepare micelles: Micelles are a different type of dispersed system formed by the aggregation of surfactant molecules in a liquid. Bredig's arc method is not typically used to prepare micelles.

Ques 43. The formation of micelles takes place.

- 1. Only above a particular temperature and above a particular concentration**
- 2. Only below a particular temperature and below a particular concentration**
- 3. Only above Kraft temperature and below CMC**
- 4. Only below Kraft temperature and above CMC**

Solu. The formation of micelles takes place:

1. Only above a particular temperature (Kraft temperature) and above a particular concentration (critical micelle concentration, CMC).

Here's why:

- **Micelles:** Micelles are formed by amphiphilic molecules, which have both a hydrophilic (water-loving) head group and a hydrophobic (water-hating) tail group.

- Critical micelle concentration (CMC): This is the minimum concentration of amphiphilic molecules required for micelle formation. Below the CMC, the molecules exist as single entities in the solution.
- Kraft temperature: This is the minimum temperature above which micelles can form for a specific amphiphile. Below the Kraft temperature, the thermal energy isn't sufficient to overcome the interactions between the hydrophobic tails and the water molecules.

Therefore, for micelles to form, both conditions need to be met:

1. The concentration of the amphiphile must be above the CMC.
2. The temperature must be above the Kraft temperature.

Ques 44. The Arseneous sulphide As_2S_3 sol has negative (-) charge. The maximum power to precipitate it is of:

1. H_2SO_4
2. Na_3PO_4
3. CaCl_2
4. AlCl_3

Solu. The maximum power to precipitate a negatively charged As_2S_3 sol is with 4. AlCl_3 .

Here's why:

- Charged Colloids and Precipitation: Colloidal particles can have a surface charge, either positive or negative. This charge plays a crucial role in their stability. Oppositely charged ions have a stronger attraction to the colloid and can cause precipitation.
- Explanation: As_2S_3 sol is negatively charged. According to the Schulze-Hardy rule, the higher the valence of the cation (positive ion) in an electrolyte, the greater its coagulating power (ability to cause precipitation) for a negatively charged colloid.

Therefore, AlCl_3 with its trivalent Al^{3+} cations is the most effective electrolyte for precipitating the negatively charged As_2S_3 sol.

Ques 45. When KI solution is added to AgNO_3 solution such that AgNO_3 amount exceeds KI amount.

- 1. The precipitated AgI adsorbs I⁻ ions from KI solution and negatively charged colloidal sol result**
- 2. The precipitated AgI adsorbs Ag⁺ ions from KI solution and positively charged colloidal sol result**
- 3. The precipitated KI adsorbs NO₃⁻ ions from AgNO₃ and negative charged colloidal sol results**
- 4. No colloidal sol. formation takes place**

Solu. The correct answer is: 1. The precipitated AgI adsorbs I⁻ ions from KI solution and negatively charged colloidal sol results.

Here's why:

- When silver nitrate (AgNO₃) solution is added to potassium iodide (KI) solution, a white precipitate of silver iodide (AgI) forms due to a double displacement reaction:
$$\text{AgNO}_3 (\text{aq}) + \text{KI} (\text{aq}) \rightarrow \text{AgI} (\text{s}) + \text{KNO}_3 (\text{aq})$$
 - However, in the scenario where the amount of AgNO₃ exceeds the amount of KI, there will be some unreacted Ag⁺ ions remaining in the solution.
 - Adsorption: Silver iodide (AgI) has a strong affinity for iodide ions (I⁻). This means the surface of the AgI precipitate can attract and hold onto some of the excess I⁻ ions from the remaining KI solution.
 - Charge on the Colloid: Due to the adsorption of negatively charged I⁻ ions on the AgI surface, the overall colloidal particle acquires a net negative charge.
-